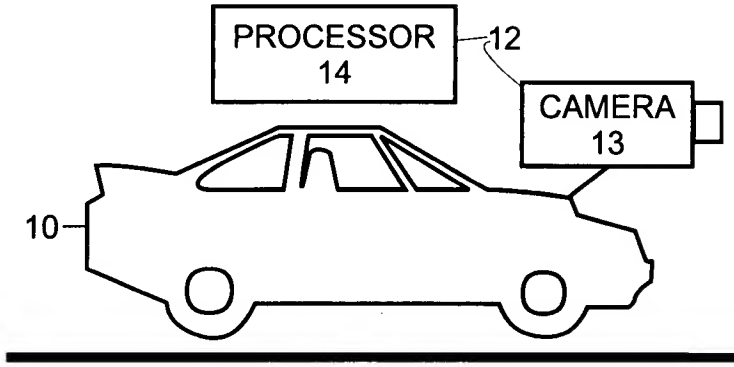


FIG. 1

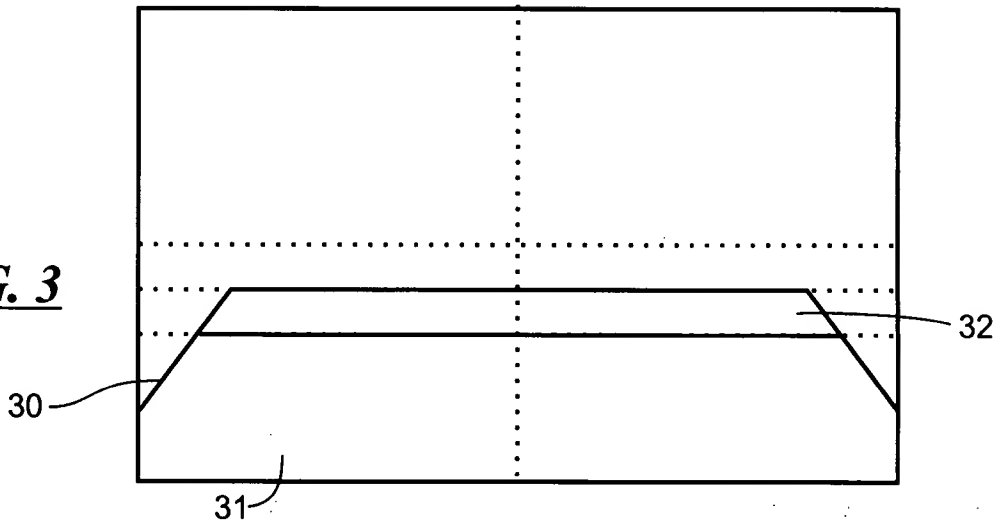
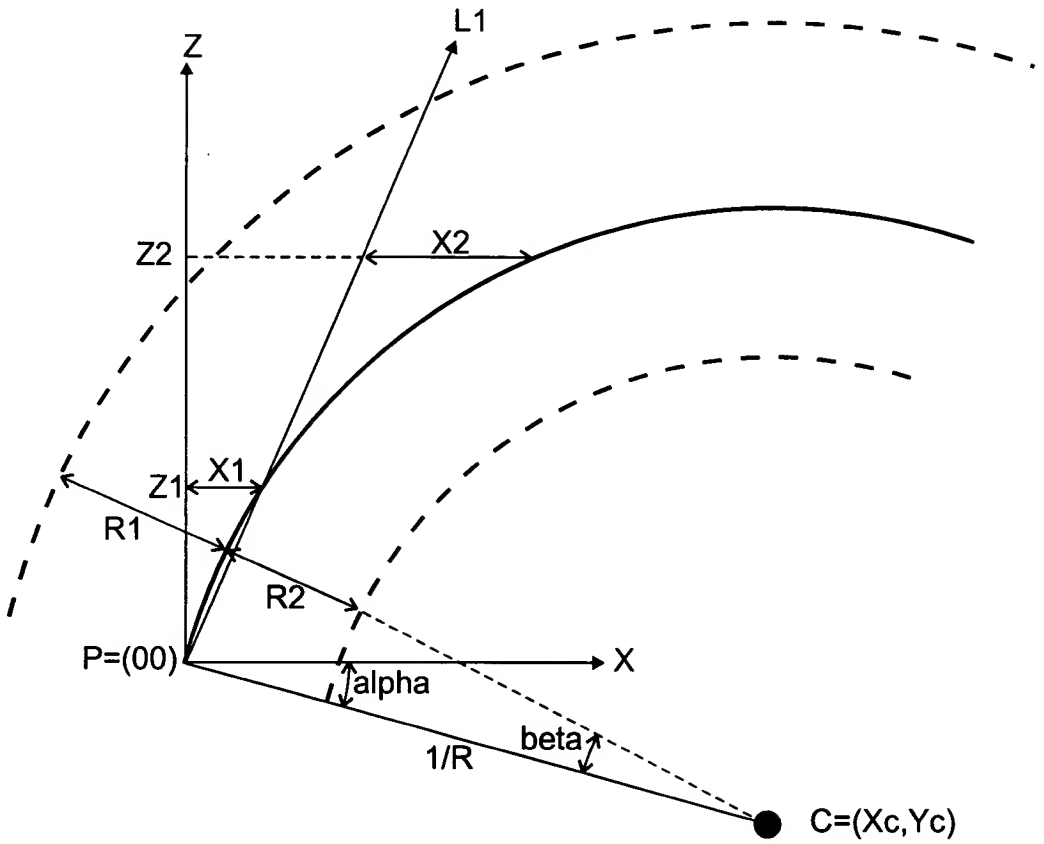


FIG. 3



F I G. 2

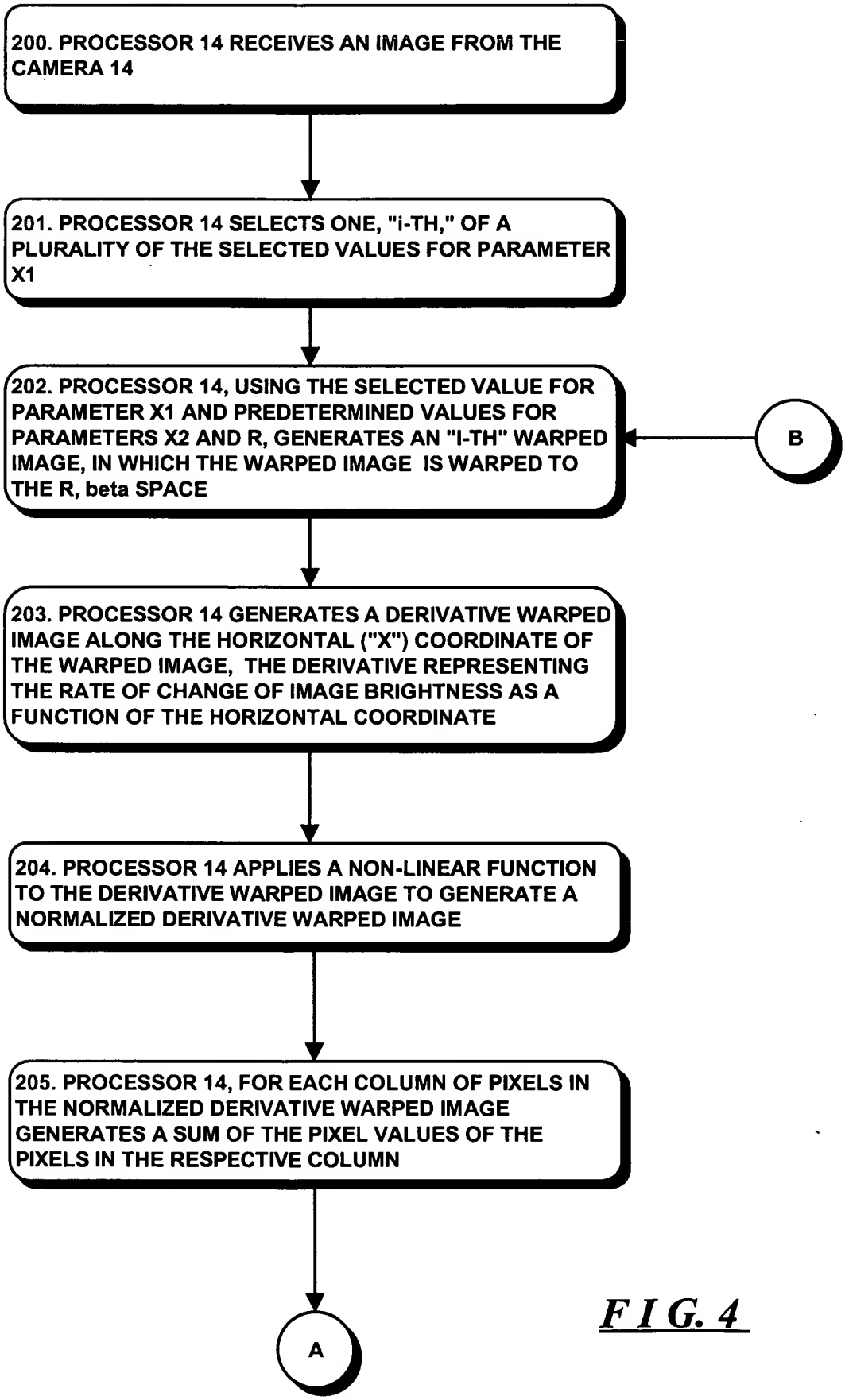

200. PROCESSOR 14 RECEIVES AN IMAGE FROM THE CAMERA 14
201. PROCESSOR 14 SELECTS ONE, "i-TH," OF A PLURALITY OF THE SELECTED VALUES FOR PARAMETER X1
202. PROCESSOR 14, USING THE SELECTED VALUE FOR PARAMETER X1 AND PREDETERMINED VALUES FOR PARAMETERS X2 AND R, GENERATES AN "I-TH" WARPED IMAGE, IN WHICH THE WARPED IMAGE IS WARPED TO THE R, beta SPACE
B
203. PROCESSOR 14 GENERATES A DERIVATIVE WARPED IMAGE ALONG THE HORIZONTAL ("X") COORDINATE OF THE WARPED IMAGE, THE DERIVATIVE REPRESENTING THE RATE OF CHANGE OF IMAGE BRIGHTNESS AS A FUNCTION OF THE HORIZONTAL COORDINATE
204. PROCESSOR 14 APPLIES A NON-LINEAR FUNCTION TO THE DERIVATIVE WARPED IMAGE TO GENERATE A NORMALIZED DERIVATIVE WARPED IMAGE
205. PROCESSOR 14, FOR EACH COLUMN OF PIXELS IN THE NORMALIZED DERIVATIVE WARPED IMAGE GENERATES A SUM OF THE PIXEL VALUES OF THE PIXELS IN THE RESPECTIVE COLUMN
A

FIG. 4

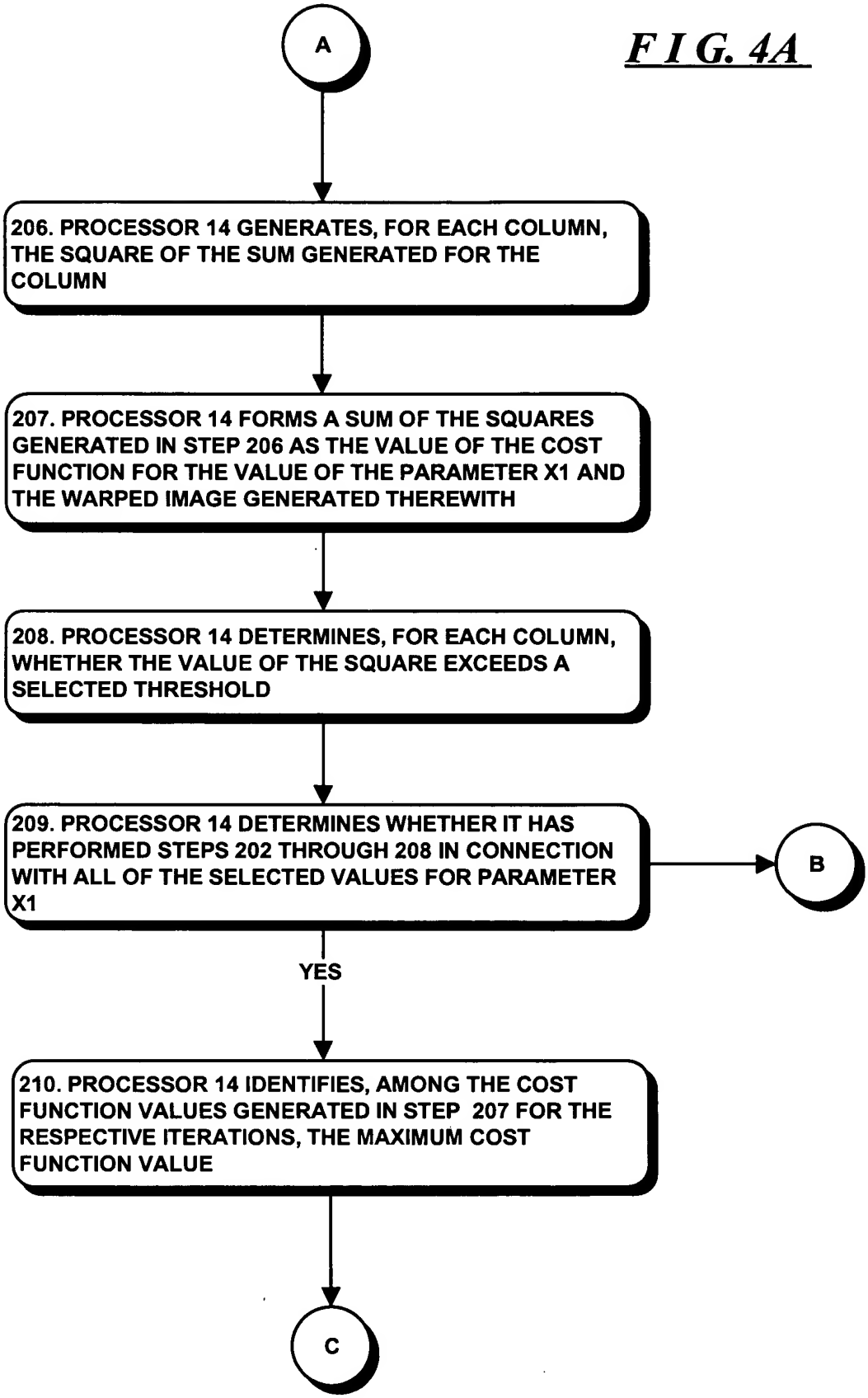

A
206. PROCESSOR 14 GENERATES, FOR EACH COLUMN, THE SQUARE OF THE SUM GENERATED FOR THE COLUMN
207. PROCESSOR 14 FORMS A SUM OF THE SQUARES GENERATED IN STEP 206 AS THE VALUE OF THE COST FUNCTION FOR THE VALUE OF THE PARAMETER X1 AND THE WARPED IMAGE GENERATED THEREWITH
208. PROCESSOR 14 DETERMINES, FOR EACH COLUMN, WHETHER THE VALUE OF THE SQUARE EXCEEDS A SELECTED THRESHOLD
209. PROCESSOR 14 DETERMINES WHETHER IT HAS PERFORMED STEPS 202 THROUGH 208 IN CONNECTION WITH ALL OF THE SELECTED VALUES FOR PARAMETER X1
B
YES
210. PROCESSOR 14 IDENTIFIES, AMONG THE COST FUNCTION VALUES GENERATED IN STEP 207 FOR THE RESPECTIVE ITERATIONS, THE MAXIMUM COST FUNCTION VALUE
C

FIG. 4A

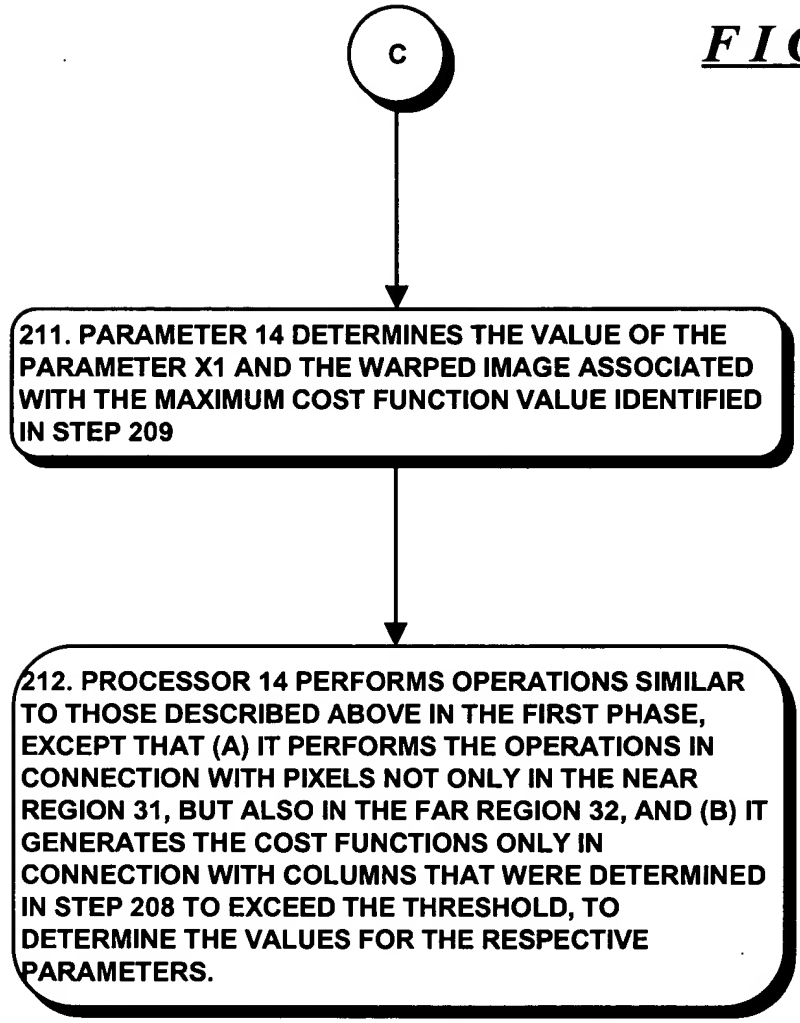

C
211. PARAMETER 14 DETERMINES THE VALUE OF THE PARAMETER X1 AND THE WARPED IMAGE ASSOCIATED WITH THE MAXIMUM COST FUNCTION VALUE IDENTIFIED IN STEP 209
212. PROCESSOR 14 PERFORMS OPERATIONS SIMILAR TO THOSE DESCRIBED ABOVE IN THE FIRST PHASE, EXCEPT THAT (A) IT PERFORMS THE OPERATIONS IN CONNECTION WITH PIXELS NOT ONLY IN THE NEAR REGION 31, BUT ALSO IN THE FAR REGION 32, AND (B) IT GENERATES THE COST FUNCTIONS ONLY IN CONNECTION WITH COLUMNS THAT WERE DETERMINED IN STEP 208 TO EXCEED THE THRESHOLD, TO DETERMINE THE VALUES FOR THE RESPECTIVE PARAMETERS.

FIG. 4B

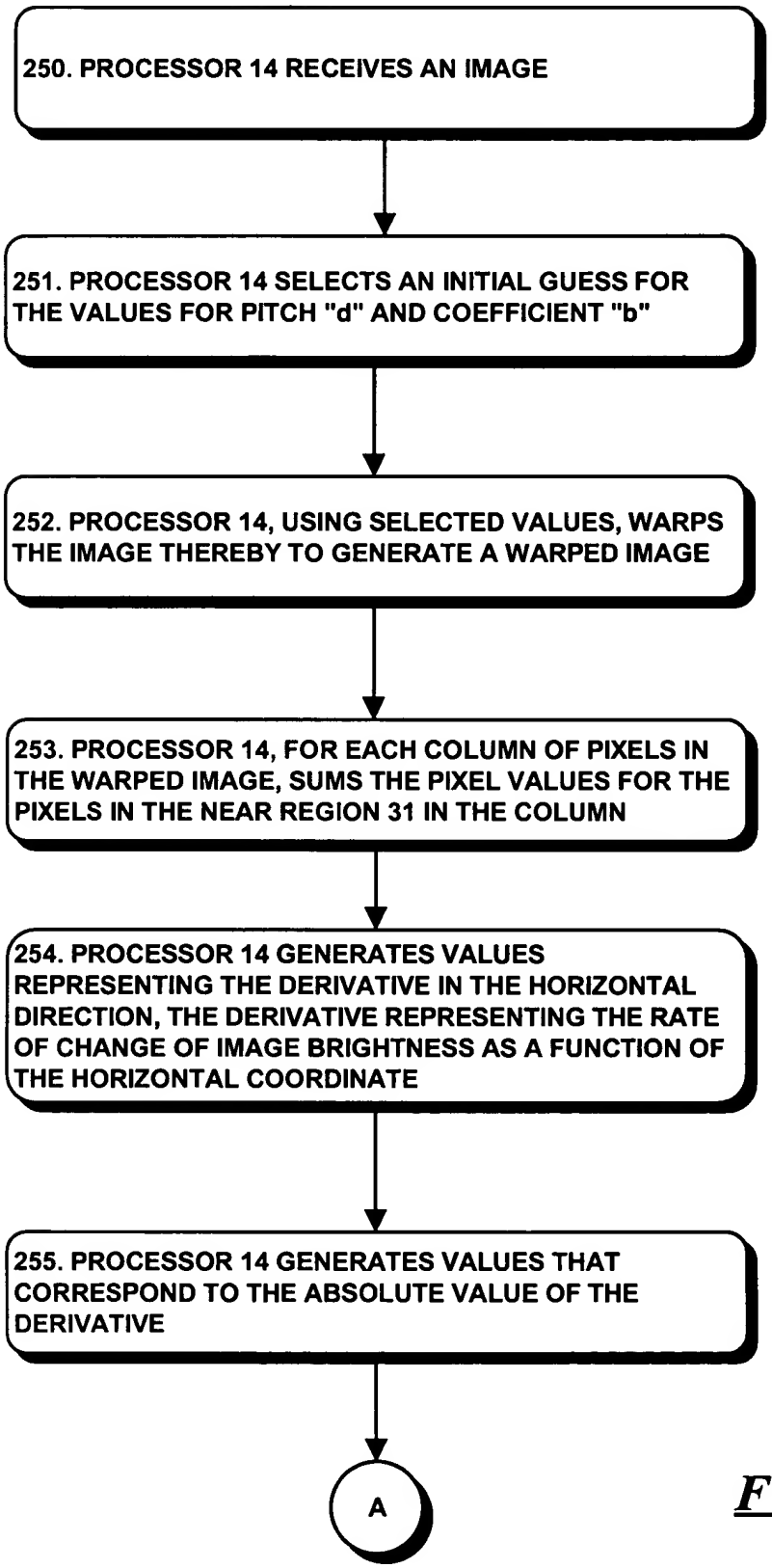

250. PROCESSOR 14 RECEIVES AN IMAGE
251. PROCESSOR 14 SELECTS AN INITIAL GUESS FOR THE VALUES FOR PITCH "d" AND COEFFICIENT "b"
252. PROCESSOR 14, USING SELECTED VALUES, WARPS THE IMAGE THEREBY TO GENERATE A WARPED IMAGE
253. PROCESSOR 14, FOR EACH COLUMN OF PIXELS IN THE WARPED IMAGE, SUMS THE PIXEL VALUES FOR THE PIXELS IN THE NEAR REGION 31 IN THE COLUMN
254. PROCESSOR 14 GENERATES VALUES REPRESENTING THE DERIVATIVE IN THE HORIZONTAL DIRECTION, THE DERIVATIVE REPRESENTING THE RATE OF CHANGE OF IMAGE BRIGHTNESS AS A FUNCTION OF THE HORIZONTAL COORDINATE
255. PROCESSOR 14 GENERATES VALUES THAT CORRESPOND TO THE ABSOLUTE VALUE OF THE DERIVATIVE
A

FIG. 5

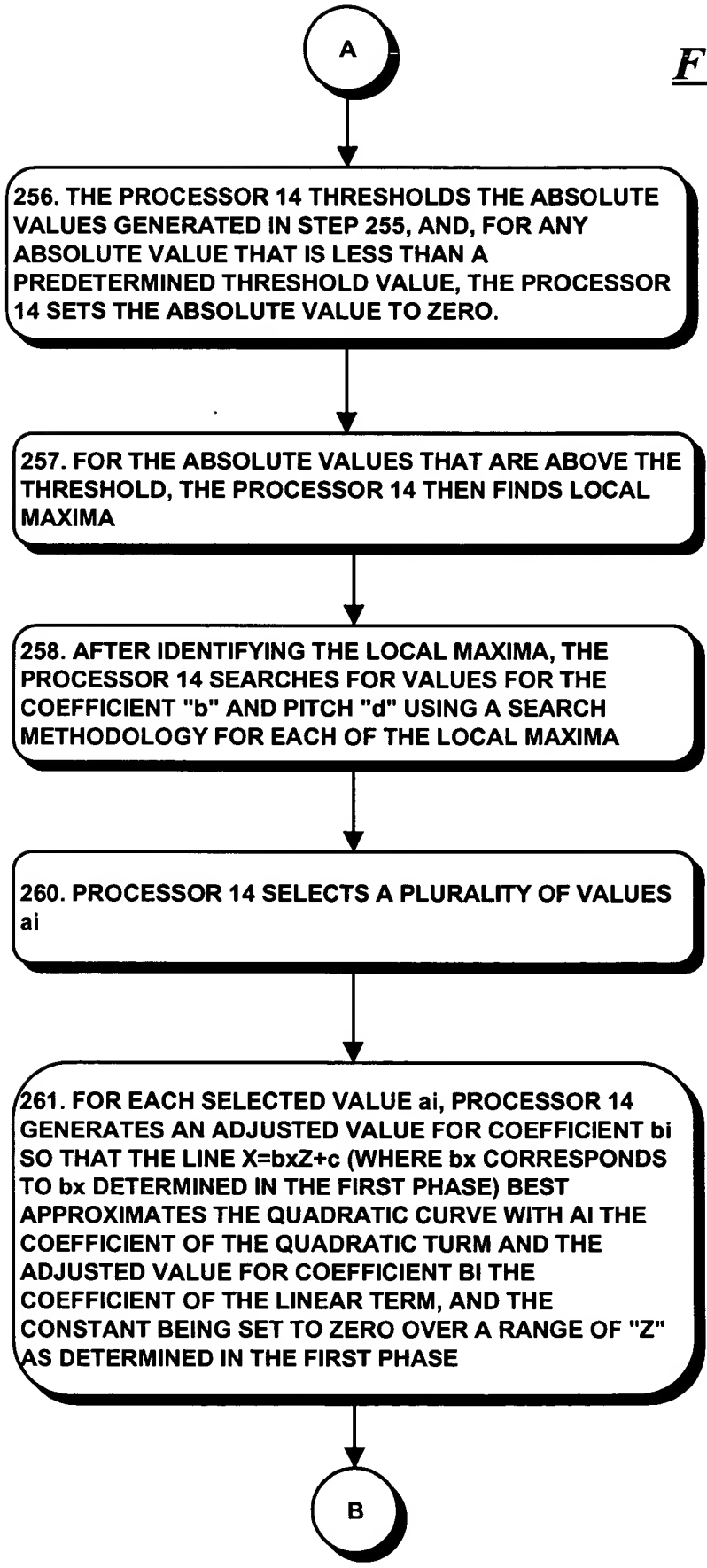

A
256. THE PROCESSOR 14 THRESHOLDS THE ABSOLUTE VALUES GENERATED IN STEP 255, AND, FOR ANY ABSOLUTE VALUE THAT IS LESS THAN A PREDETERMINED THRESHOLD VALUE, THE PROCESSOR 14 SETS THE ABSOLUTE VALUE TO ZERO.
257. FOR THE ABSOLUTE VALUES THAT ARE ABOVE THE THRESHOLD, THE PROCESSOR 14 THEN FINDS LOCAL MAXIMA
258. AFTER IDENTIFYING THE LOCAL MAXIMA, THE PROCESSOR 14 SEARCHES FOR VALUES FOR THE COEFFICIENT "b" AND PITCH "d" USING A SEARCH METHODOLOGY FOR EACH OF THE LOCAL MAXIMA
260. PROCESSOR 14 SELECTS A PLURALITY OF VALUES ai
261. FOR EACH SELECTED VALUE ai, PROCESSOR 14 GENERATES AN ADJUSTED VALUE FOR COEFFICIENT bi SO THAT THE LINE X=bxZ+c (WHERE bx CORRESPONDS TO bx DETERMINED IN THE FIRST PHASE) BEST APPROXIMATES THE QUADRATIC CURVE WITH AI THE COEFFICIENT OF THE QUADRATIC TURM AND THE ADJUSTED VALUE FOR COEFFICIENT BI THE COEFFICIENT OF THE LINEAR TERM, AND THE CONSTANT BEING SET TO ZERO OVER A RANGE OF "Z" AS DETERMINED IN THE FIRST PHASE
B

FIG. 5A

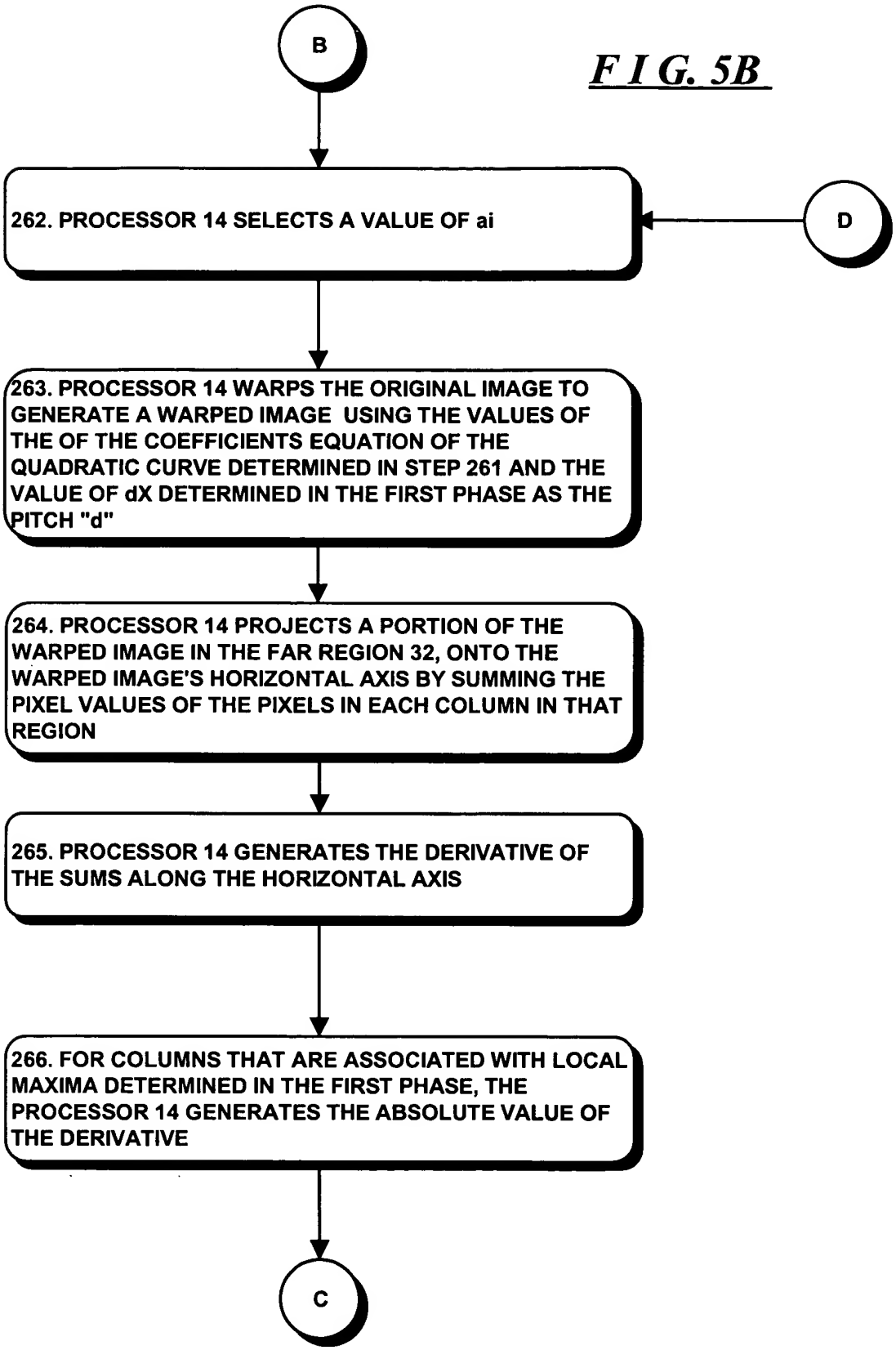

B
262. PROCESSOR 14 SELECTS A VALUE OF ai
D
263. PROCESSOR 14 WARPS THE ORIGINAL IMAGE TO GENERATE A WARPED IMAGE USING THE VALUES OF THE OF THE COEFFICIENTS EQUATION OF THE QUADRATIC CURVE DETERMINED IN STEP 261 AND THE VALUE OF dX DETERMINED IN THE FIRST PHASE AS THE PITCH "d"
264. PROCESSOR 14 PROJECTS A PORTION OF THE WARPED IMAGE IN THE FAR REGION 32, ONTO THE WARPED IMAGE'S HORIZONTAL AXIS BY SUMMING THE PIXEL VALUES OF THE PIXELS IN EACH COLUMN IN THAT REGION
265. PROCESSOR 14 GENERATES THE DERIVATIVE OF THE SUMS ALONG THE HORIZONTAL AXIS
266. FOR COLUMNS THAT ARE ASSOCIATED WITH LOCAL MAXIMA DETERMINED IN THE FIRST PHASE, THE PROCESSOR 14 GENERATES THE ABSOLUTE VALUE OF THE DERIVATIVE
C

FIG. 5B

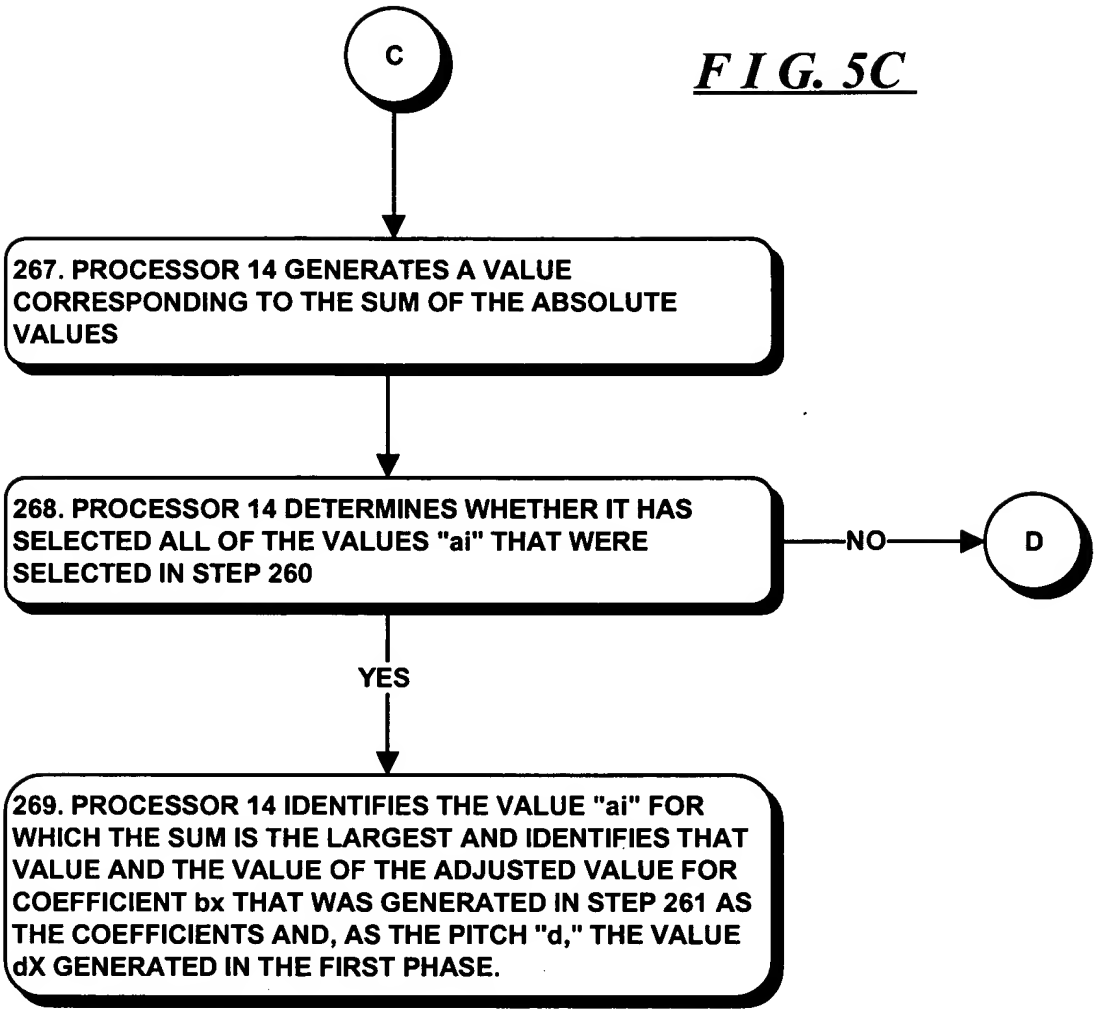

C
267. PROCESSOR 14 GENERATES A VALUE CORRESPONDING TO THE SUM OF THE ABSOLUTE VALUES
268. PROCESSOR 14 DETERMINES WHETHER IT HAS SELECTED ALL OF THE VALUES "ai" THAT WERE SELECTED IN STEP 260
NO
D
YES
269. PROCESSOR 14 IDENTIFIES THE VALUE "ai" FOR WHICH THE SUM IS THE LARGEST AND IDENTIFIES THAT VALUE AND THE VALUE OF THE ADJUSTED VALUE FOR COEFFICIENT bx THAT WAS GENERATED IN STEP 261 AS THE COEFFICIENTS AND, AS THE PITCH "d," THE VALUE dX GENERATED IN THE FIRST PHASE.

FIG. 5C